

Antigorite CPO measured by U-stage, EBSD and synchrotron X-rays

SODA, Yusuke^{1*} ; ANDO, Jun-ichi² ; URATA, Yoshito² ; WENK, Hans-rudolf³

¹Kanazawa University, ²Hiroshima University, ³University of California, Berkeley

Foliated antigorite serpentinite with crystallographic preferred orientation (CPO) probably causes shear wave splitting observed at subduction zones (e.g., Katayama et al., 2009). Therefore, the study of type and intensity of antigorite CPO is an important to understand the detail of this phenomenon.

Soda and Wenk (2014) measured CPOs of antigorite serpentinite from the Sashu Fault at the Saganoseki Peninsula, Oita Prefecture, by three independent methods, U-stage (with optic microscope), EBSD and synchrotron X-rays. The obtained antigorite CPOs by three methods are almost same without the fabric strength, maxima of pole figures in multiples of random distribution. The fabric strength decreases in the following order, U-stage >EBSD >synchrotron X-rays, which is probably caused by the characteristics of three methods. Through U-stage measurement, we can obtain the fabric pattern of antigorite CPO mainly from coarser antigorite grains (>30 μm). In the case of EBSD measurement, we measure antigorite CPO within an area of ca. 0.8 mm \times 0.8 mm. Measurement points of only ca. 30% can be used to make fabric patterns. Residual ca. 70% points are neglect, because the quality of Kikuchi lines from them is too low to identify the orientation. In the synchrotron X-rays method, the result represents the bulk fabric from a volume of ca. 0.5 mm \times 0.5 mm \times 1.0mm.

The serpentinite measured antigorite CPO develops mylonitic structures with a penetrative foliation and lineation (Soda and Takagi, 2010). The antigorite grains show undulose extinction. And their grain boundary is unclear under the microscopy. Mg# (Mg/(Mg+Fe)) of antigorite grains is wide range 0.98-0.88. The BSE images indicate Fe-rich antigorite infilling the grain boundaries and fractures of Mg-rich antigorite.

The same serpentinite has already observed by TEM (Urata et al., 2009). The results indicate that the m-values of antigorite grains, the number of octahedral along the [100] modulation wave, make two groups, high m-value (16-18) and low m-value (13-14). This result suggests that the antigorite are crystallized mainly two stages, which is supported by the variation of Fe contents of antigorite (Fe-rich and Mg-rich). The Mg-rich antigorite grains are main minerals composed of the serpentinite, Fe-rich antigorite grains occupy at the periphery of the others and within the vein. The TEM observation indicates that the Mg-rich antigorite grains are subdivided into sub-grain with 50-100 nm in size, which can be recognized as an undulose extinction under optic microscope.

These microstructures of antigorite grains potentially influence the outcome of CPO measurements. The weaker fabric patterns from the synchrotron X-rays are probably attributed to the fine-grained antigorite crystallized at the deferent stages and to sub-grain. And the U-stage and EBSD measurements focus only the selected grains, which may result in overestimation of elastic wave anisotropy of serpentinite.

References

- Katayama et al, 2009, Nature 461, 1114-1117.
- Soda and Takagi, 2010, Journal of Structural Geology 32, 792-802.
- Soda and Wenk, 2014, Tectonophysics, in press
- Urata et al., 2009, AGU2009 abstract. MR41A-1858.

Keywords: antigorite, CPO, synchrotron X-ray, elastic anisotropy